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ABSTRACT

Differences between the sexes in patterns of responses to vocational interest questionnaires were investigated by multidimensional scaling methods. The twelve areas of interest, based on a U.S.Employment Service study, were: artistic, scientific, nature, protective, mechanical, routine, clerical, persuasive, service, humanitarian, social-business, and entertaining. An Occupational Activities Preference (OAP) instrument was designed to elicit expressions of preference among all 66 possible comparisons. Responses were analyzed separately for a sample of 392 high school females and for a sample of 356 high school males. Multidimensional scaling of the preferences showed three clusters of preferences for each sex, but different patterns of clusters. It appeared that service and technical areas had different connotations for high school males and for high school females. These differences in values and expectations have implications for vocational psychology and counseling. (CTM)

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A Multidimensional Scaling Study of Gender Bias in Service and Technical Interests[1]

Clifford E. Lunneborg

Abstract

A major gender bias in vocational interest assessment, the tendency of males and females to be strongly differentiated along a Service-Technical dimension, was investigated using multi-dimensional scaling of occupational activity preferences. The hypothesis that men and women have separate normative cognitive generalizations about vocational behaviors was supported by the different activity clusters formed. High School women viewed service activities as humanitarian and as a means of personal accomplishment, while technical activities were linked with anonymous contributions to organizational functioning. Their male counterparts treated technical activities as providing an arena for individual achievements, while service activities were associated with a condition of servitude. Implications of these distinct generalizations for career counseling are drawn.

[1]Research reported here was described at the annual meeting of the American Educational Research Association, Toronto, Ontario, 29 March 1978. Support of the Washington Pre-College Testing Program in collecting and providing Occupational Activities Preference data is acknowledged.

EAC Project 617

A Multidimensional Scaling Study of Gender Bias in Service and Technical Interests

Certainly the two most frequently documented findings in the assessment of vocational interests are that women's measured interest in service and social activities exceeds that of men, and that men's interest in the technical and mechanical is considerably greater than is women's. This service-technical gap is large and amazingly robust. Even when considerable pains are taken to construct interest scales to be free of gender bias the effect does not disappear. Lunneborg (in press) reports significant differences between high school mean and women on a Service vs. Technical measure from the Vocational Interest Inventory (Lunneborg, 1977) and on the Working with People vs. Working with Things dimension of the Unisex version of the ACT Interest Inventory (Hanson, Prediger, and Schussel, 1977). Both instruments were carefully constructed to control for gender differences, selecting out items which showed reliable differences between men and women respondents.

Given the consistency with which such findings have been noted, whether interest scales are theoretically derived (based on structural models such as those of Holland or Roe) or are empirically derived (based on items which cluster as a result of a factor or similar multidimensional analysis), counseling and vocational psychologists are challenged to explain or interpret the resulting bias. Interests are presumed learned in some fashion and it is natural, therefore, to propose that the normative reinforcement histories of adolescent men and women must be responsible for gender interest differences.

The present research does not test that reinforcement hypothesis. Rather, it proceeds from noting that even were the hypothesis known to be correct, we still would not know how the differential reinforcement worked. One possibility is that reinforcement has been of specific activities and that this very specificity persists to bias the measurement of developed interests. By eliminating from consideration only those activities which have had different reinforcement histories for male than for female adolescents, and, hence, are now differentially responded to, the authors of the VII and the UNIACT inventories seek to assess individual interest strengths with gender neutral items.

An alternative to this specific activities approach is that the different normative reinforcement histories for the two genders yield not only different preferences for activities, but generalized differences in cognitions about activities. That is, men and women may come to see activities as differently organized and, hence, may view "interest areas" in distinct ways.

It is this possibility that the present research addressed. The approach taken was to determine how men and women cluster or group vocational activities. These clusters would be expected to be based upon learned cognitive generalizations. Indeed, the nature of these generalizations might be inferred from the particular clusters formed. If women and men formed the same clusters, grouped the same activities together, their normative cognitive generalizations about work activities could not be presumed to differ. Should the clusters formed by women be unlike those formed by men, however, differences in cluster composition could then be explored to suggest differences in the cognitive generalizations arrived at normatively by the two genders.

Vocational activities spanning the world of work were included in the clustering. These included but were not limited to activities commonly associated with Service and Technical interests. Of central importance was how (or whether) Service and Technical activities would be clustered with other activities. For example, if certain technical activities were placed in a different cluster by women than they were by men, the two genders may be judged to have arrived at different cognitive generalizations about those technical activities.

Briefly, the research was motivated by the desire to determine whether men and women have different ideas of what Service means or of what Technical is like. If they do, then it is these cognitions that provide a potential basis for career counseling intervention. Men's beliefs, for example, about service activities may affect their interests, and, hence, their participation. Counseling directed at exploring these beliefs may be as effective tool in broadening interests and participation.

Method

This study drew upon a set of vocational interest foci or activity areas suggested by research conducted by the U.S. Employment service, in support of the development of a USES interest inventory (Droege and Hawk, Note 1). Eleven of the foci were factor analytically inferred--Artistic (ART), Scientific-Technical (SCI), Nature-Outdoors (OUT), Protective (PRO), Mechanical-Technical (MEC), Routine (ROU), Clerical-Business (CLR), Persuasive (PER), Accommodating (ACC), Humanitarian (HUM), Social-Business (ORG)--while a twelfth, Diverting (DIV), was added for

completeness. While the number and precise characterization of interest areas varies from one formulation to another, these results are certainly not atypical. The twelve areas were intended by USES to encompass all occupational interests and appear to do so. Although USES graciously provided working definitions of the twelve interest areas (Kuptzin, Note 2), this study was conducted independent of USES and did not make use of any USES instrumentation.

Instrumentation. Table 1 gives the definitions of the twelve interest areas as provided by USES. Thus, Artistic was defined as "interest in creative and imaginative expressions of feelings or ideas." Each of these definitions was rewritten in a shortened form by the author to provide a set of stems, also reported in Table 1. The Nature-Outdoors stem, for example, was "working outdoors with plants and animals."

An Occupational Activities Preference (OAP) instrument was constructed by systematically pairing all stems. Each pair defined an item and the resulting 66 items were systematically ordered to reduce to a minimum the occurrence of the same stem in neighboring items. Allocation of first (A) or second (B) position to a stem within an item was also controlled so that each stem appeared approximately the same number of times in the leading as in the following position. Instructions were prepared directing respondents to select, for each item, the one description of work activities which interested them most.

Table 1

The Twelve USES Interest Areas: Abbreviation, Title, USES Definition, and Occupational Activities Preference Stems

ART Artistic. Interest in creative and imaginative expressions of feelings or ideas.
"Expressing feelings or ideas creatively"

SCI Scientific-Technical. Interest in original and creative research to understand the physical world and in application of the findings to practical problems in science and medicine.
"Conducting research or applying research findings to practical problems"

OUT Nature-Outdoors. Interest in outdoor activities related to plants and animals.
"Working outdoors with plants and animals"

PRO Protective. Interest in (often) adventurous or dangerous activity to safeguard people and property.
"Protecting people and their property"

MEC Mechanical-Technical. Interest in applying mechanical technology to practical situations, using machines, hand tools, and other techniques.
"Applying technology--through the use of machines, tools, or other techniques--to practical situations"

ROU Routine. Interest in repetitive, concrete, organized activities primarily in factory and manufacturing settings.
"Manufacturing goods for society"

Table 1 continued

CLR Clerical-Business Interest in systematic, highly organized verbal and numerical activities in office settings.
"Applying verbal or numerical skills within a business or other organization"

PER Persuasive. Interest in promoting products and applying sales techniques to bring others to a point of view.
"Convincing others of a point of view or promoting a product or service"

ACC Accommodating. Interest in providing routine personalized services to those who want them.
"Providing personalized services to those who want them"

HUM Humanitarian. Interest in understanding the needs of helpless individuals or those who have serious mental, spiritual, or physical problems and providing them with direct and personal help.
"Understanding and directly meeting the needs of those with serious problems"

ORG Social-Business. Interest in leadership, management, or other high level verbal-numerical activities in social, business, or educational organizations.
"Providing management or leadership to a business or other organization"

DIV Diverting. Interest in personal showmanship in a variety of settings.
"Personally entertaining others"

Subjects. The OAP was completed by a sample of high school juniors (392 women and 356 men) participating in the Washington Pre-College Testing Program during the Spring of 1977. The OAP was one of several experimental tests included in the battery of achievement, aptitude and interest measures taken by Washington high school juniors contemplating post-secondary education. Experimental tests were randomly distributed among several testing sites and dates used for administration of the battery.

Analysis. Scale scores for each of the 12 areas were computed for each student. Each score represents the number of times that work activity was selected as more interesting than the contrast activity and the set of 12 provide for the ipsative or relative measure of strength of interest in the areas. For the present study these scale scores were used solely to profile the mean performance of the male and female students.

Response splits for each item were obtained separately for male and female respondents. These were used to generate the confusion matrices needed for multidimensional scaling of the work activities. A fifty-fifty split of preferences between two contrasted activities indicates maximum confusion or similarity between the two and is coded 50. Wider splits mean less confusion and are coded with the smaller of the two figures, i.e., 25 for a 75-25 split. Multidimensional scalings were accomplished using the MDSCAL (Version 4M) algorithm of Kruskal (Note 3).

Results

Scale means, separately for men and women, are profiled in Figure 1. Scale scores from the OAP were such that 5.5 represented a point of

indifference, a score which would result if an activity were found to be neither no more nor no less interesting when compared with all alternatives. Very pronounced differences between the sexes were found on the Mechanical-Technical (MEC), Accommodating (ACC) and Humanitarian (HUM) scales. The first favors males, the latter two females, and together they provide a replication of the customary service-technical gap.

Table 2 gives the confusion matrices for the two groups. Female data are given above to the right of the diagonal. Entries range from a low of 18 for the pair Routine/Humanitarian (least similar) to highs of 49 for Scientific-Technical/Social-Business, for Nature-Outdoors/Humanitarian, and for Protective/Clerical-Business. For the male group, the entries in the lower half of the table range from 18 for Mechanical-Technical/Routine to a 50 (maximum) for Routine/Humanitarian and for Routine/Diverting.

In the MDSCAL analyses the number of dimensions was varied between one and four. For both male and female data, the stress and other completeness of convergence data suggested structures of three dimensions. The stress values of 9.6% (male) and 9.3% (female) signify Good (though not Excellent) fits to the data (Note 3). Tables 3 and 4 indicate the final configuration of the twelve work interests on three dimensions for male and for female students. Plotted in three-dimensions these same configurations appear as Figures 2 and 3 as well.

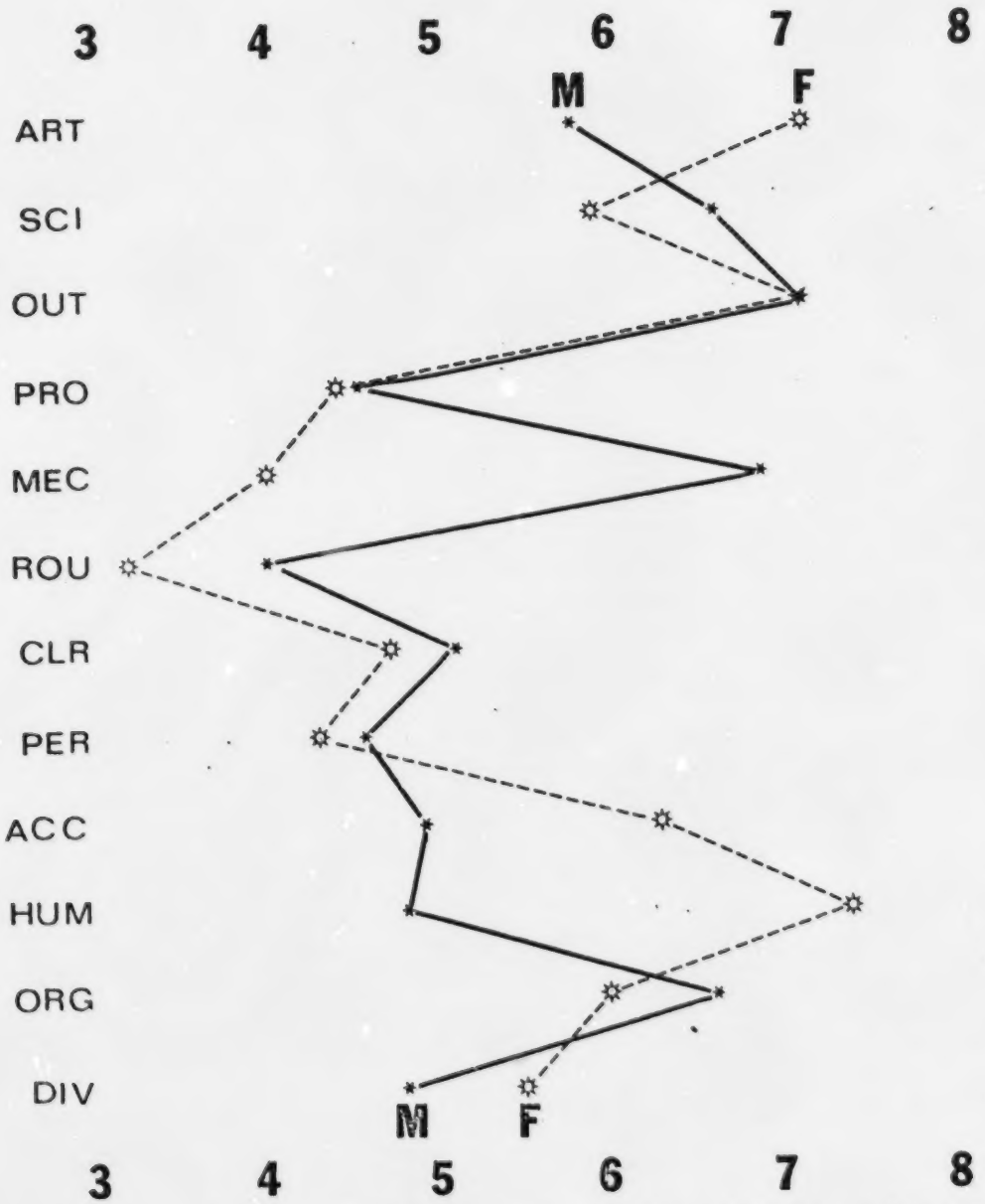

Figure 1. Mean profiles of occupational activities preference scales for high school males and females.

Table 2

Confusion (Similarity) Matrices for the Twelve USES Work Interest Areas[a]

	ART	SCI	OUT	PRO	MEC	ROU	CLR	PER	ACC	HUM	ORG	DIV	
ART		31	45	25	27	24	31	29	42	48	37	38	ART
SCI	47		34	28	25	28	37	34	45	35	49	44	SCI
OUT	39	43		24	28	20	36	27	42	49	41	42	OUT
PRO	38	32	28		47	37	49	48	33	23	37	42	PRO
MEC	40	50	49	32		41	40	46	31	24	32	41	MEC
ROU	39	26	23	47	18		35	35	22	18	26	32	ROU
CLR	44	36	38	42	33	37		48	38	29	33	45	CLR
PER	42	33	29	48	31	40	46		29	24	36	39	PER
ACC	41	35	32	49	31	43	45	45		33	46	41	ACC
HUM	46	34	32	48	32	50	48	46	48		38	37	HUM
ORG	45	46	44	32	48	29	31	29	37	37		46	ORG
DIV	42	36	36	46	35	50	47	49	47	48	36		DIV

[a]Values closer to 50 indicate greater closeness of preferences for two activities. Data for high school females above the diagonal and for high school males below the diagonal.

Discussion

By reference to the spatial configurations of Figures 2 and 3 and to the similarity data of Table 2 tentative clusters of interest areas were formed. For both males and females three clusters were suggested. These clusters were different for men than for women, and not embrace all twelve areas, and were somewhat clearer for women than for men.

For the women HUM (understanding the needs of those with problems), ART (expressing ideas or feelings) and OUT (working with animals and plants) formed a first cluster. Emphasizing the understanding (of human needs), the caring (for animals) and the feelings component to the Artistic area, this cluster can be broadly labelled a Social Service one. This and following clusters are depicted in Table 5.

The second women's cluster was made up of SCI (conducting research), ORG (providing organizational leadership), and DIV (personally entertaining others). The common core seems to be the high level of Personal Achievement or Responsibility associated with these activities. A third cluster for the female respondents was defined by CLR (working within an organization), PER (promoting a product or service), PRO (protecting people or property) and, possibly, MEC (applying technology and use of

Table 3

MDSCAL Final Configuration, Three Dimensions, Female Respondents

	I	II	III
1.2			
1.1			
1.0	ART		HUM
0.9			
0.8	HUM		
0.7			OUT, ACC
0.6	OUT	ROU, HUM	ART, SCI
0.5			ORG
0.4		OUT	
0.3		ORG, SCI	
0.2			
0.1	DIV	DIV	
0.0	MEC, ACC		
-0.1	CLR	ART	DIV
-0.2	ROU	MEC	
-0.3	ORG		
-0.4	PRO	PER, ACC	CLR
-0.5			
-0.6	PER	CLR, PRO	PRO
-0.7	SCI		PER
-0.8			
-0.9			

Table 3 continued

	I	II	III
-1.0			MEC
-1.1			
-1.2			
-1.3			
-1.4			ROU

Table 4

MDSCAL Final Configuration, Three Dimensions, Male Respondents

	I	II	III
1.2			
1.1		ROU	
1.0	ORG		
0.9			
0.8		PRO	OUT
0.7		ACC, HUM	
0.6	MEC		
0.5	SCI		CLR
0.4		DIV	
0.3	ACC	PER	MEC
0.2	OUT	CLR	ORG
0.1	ART		HUM
0.0			ACC
-0.1	PRO		ART, DIV
-0.2	HUM		SCI
-0.3		ART	ROU
-0.4			
-0.5	ROU, PER		PRO
-0.6	DIV, CLR	ORG	
-0.7			PER
-0.8			
-0.9			
-1.0		OUT	
-1.1		SCI, MEC	

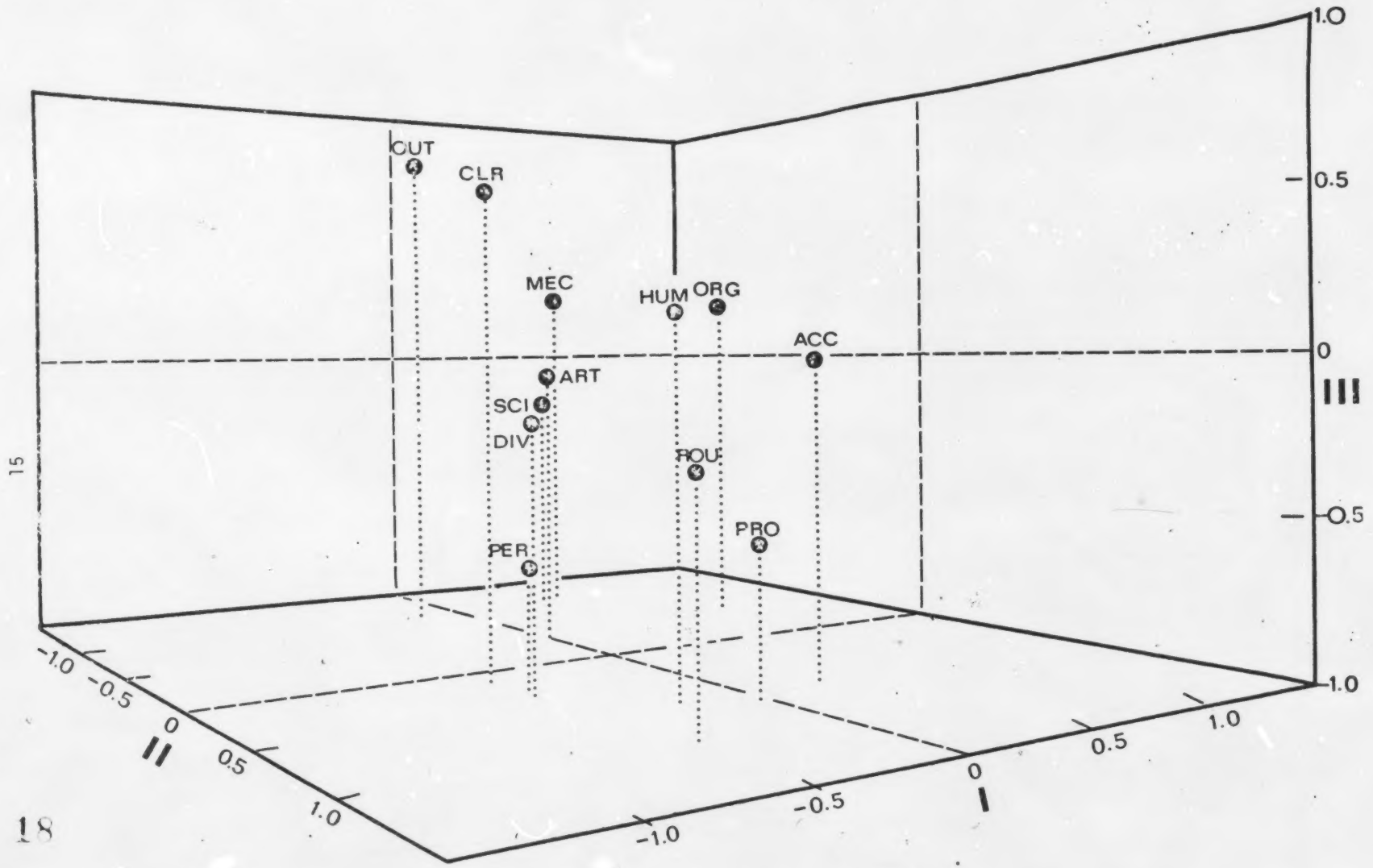

Figure 2. Final MDSCAL interest configuration for high school males.

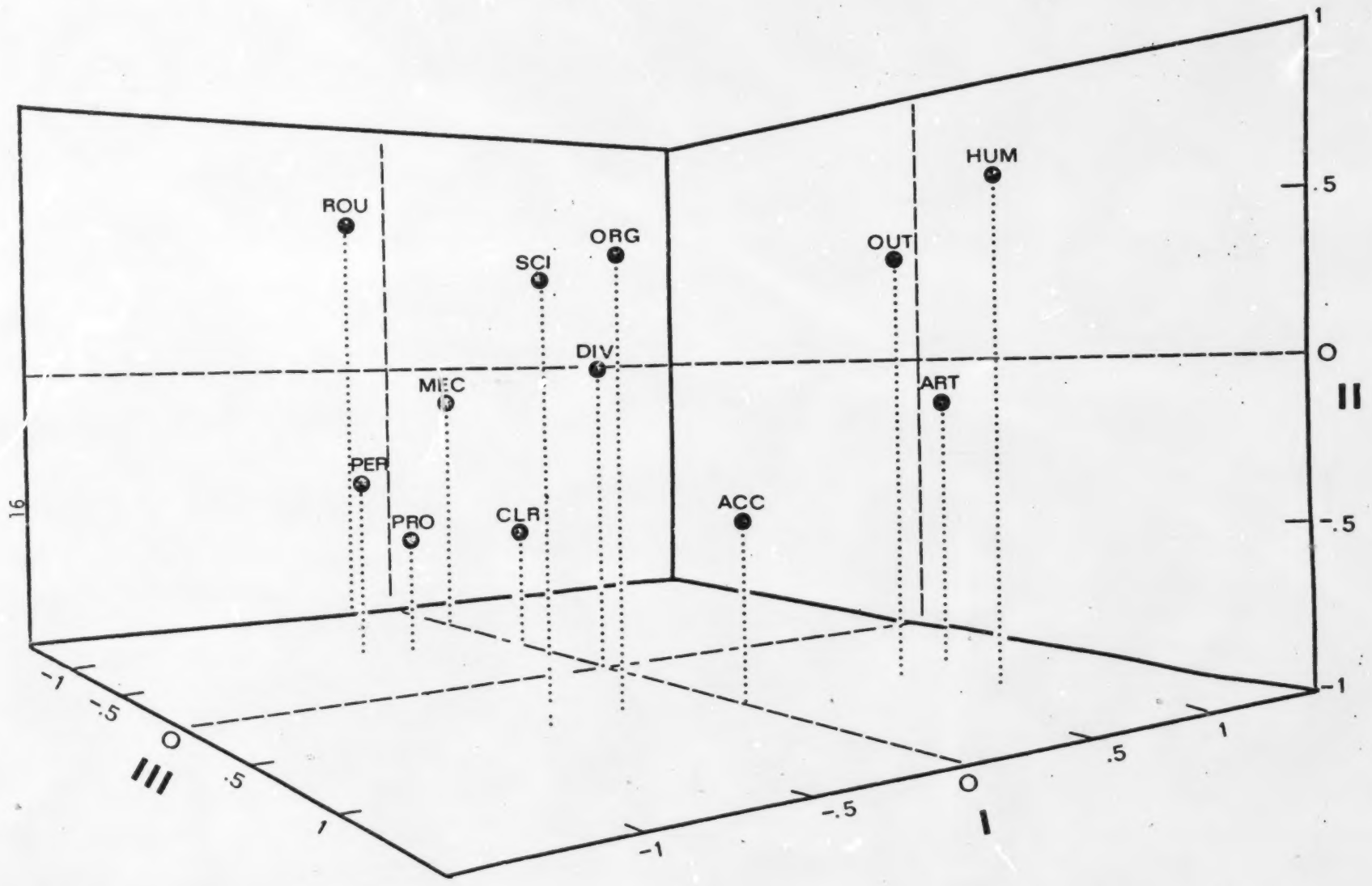

Figure 3. Final MDSCAL interest configurations for high school females.

tools). An underlying concept is less clear, although these activities are all pursued in an Organization Centered or anonymous fashion. They contrast with the personal responsibility attaching to the first two clusters. The two isolated areas for women were the relatively low level ROU (manufacturing) and ACC (personal service) activities. Interestingly ACC and HUM which are linked together as a general service area in other schemes were not seen as similar by these high school women.

The first male cluster consisted of MEC (applying technology), SCI (applying research findings) and, less strongly, ART (creative expression). In common, they suggest an interest in Technological Accomplishment. A second male grouping consisted of the pair PER (convincing others) and DIV (entertaining others). Personal Performance may capture the spirit of this cluster.

ROU (producing goods for others), PRO (protecting others) and, with slightly less strong links, ACC (providing services to others) and HUM (meeting needs of others) define a third cluster for men, one which involves Serving Others. The three remaining areas, Nature-Outdoors, Clerical-Business and Social-Business, were not strongly linked with any other areas.

The suggested clusters are quite different between the men and women. In particular, the conventional Service and Technical areas had seemingly quite different connotations for the two samples. Service for women carried the aura of understanding, of taking care of someone helpless, of having and expressing feelings. For men, however, Service

Table 5

Clusters of Interest Areas Based on MDSCAL Configurations

	Cluster Elements	Common Characteristics	Title
Female Cluster 1	Humanitarian	Understanding needs	Social Service
	Nature-Outdoors	Caring for animals	
	Artistic	Expressing feelings	
Female Cluster 2	Scientific-Technical	Conducting research	Personal Achievement
	Social-Business	Organizational leadership	
	Diverting	Personally entertaining	
Female Cluster 3	Clerical-Business	Organizational work	Organization-Centered
	Persuasive	Selling a product	
	Protective	Protecting property	
	Mechanical-Technical	Using machines	
Male Cluster 1	Mechanical-Technical	Applying technology	Technological Accomplishment
	Scientific-Technical	Applying research	
	Artistic	Creative expression	
Male Cluster 2	Persuasive	Convincing others	Personal Performance
	Diverting	Entertaining others	
Male Cluster 3	Routine	Producing goods for others	Serving Others
	Protecting	Protecting others	
	Accommodating	Providing services to others	
	Humanitarian	Meeting needs of others	

almost equates to subservience, to serving others. The respective positive and negative valences accorded Service by the two genders at this cognitive level suggest an alternative explanation to level of familiarity with and reinforcement for specific activities. Further, if these generalizations can be sustained they suggest a focus for attempts at attitude change.

This point can be reinforced by examining the picture for Technical interests. For the men technical activities were viewed as leading to (personal) accomplishment. For women, however, they were among those things one does if one joins and takes directions from some large organization. It was, then, the reverse of the Service results.

Oversimplifying, these women and men had not learned to expect personal accomplishments in Technical and Services activities respectively. Such conclusions, while tentative and begging to be replicated, do suggest that vocational psychology needs to pay as much attention to the ways in which adolescents develop their organizations of the world of work as to the formal or theoretical analysis of the structuring of work activities if techniques for satisfactory counseling are to be developed.

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